Annals of Clinical and Analytical Medicine

Original Research

Epiretinal membrane surgery challenges and results in patients with premium intraocular lens

ERM surgery in premium IOLs

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Abstract

Aim: In this study, it was aimed to evaluate the epiretinal membrane surgery challenges and results in patients with premium intraocular lens performed by an experienced surgeon in our clinic and compare with the current literature.

Material and Methods: In this retrospective study, 75 patients who underwent vitrectomy by a single surgeon were included. All patients had previously undergone phaco + iol implantation. Patients were divided into three groups according to the types of intraocular lens (Group 1: monofocal, group 2: bifocal, and group: 3 trifocal). Surgery time, retinal nipping, best-corrected visual acuity (BCVA) and Central macular thickness (CMT) were analyzed among three groups (Pre-op Post-op 6th month and Post-op 1st year).

Results: Compared to the group of monofocal IOLs, surgery time and the number of retinal nipping were significantly increased in groups of bifocal and trifocal IOLs (p<0.001). In addition, there was a significant positive correlation between surgery time and retinal nipping (p<0.001, r: 0.371**). When the Pre-op, Post-op 6th month and Post-op 1st year logMAR visual acuity values in the groups were compared, it was found that the logMAR (Logarithm of the minimum angle of resolution or recognition) visual acuity values in Post-op 6th month and Post-op 1st year increased statistically significantly compared to Pre-op logMAR (p<0.001).

Discussion: Premium lenses prolong the surgery time during vitreoretinal surgery. Since premium iols negatively affect visual acuity, it should not be recommended to patients with retinal disease. However, with careful preoperative planning, proactive familiarity with these premium IOLs, and proper contact with patients, retinal surgeons do not need to fear these sophisticated lenses.

Keywords

Cataract; Vitrectomy; Epiretinal membrane surgery; Premium intraocular lenses

DOI: 10.4328/ACAM.20565 Received: 2021-03-02 Accepted: 2021-08-14 Published Online: 2021-08-17 Printed: 2021-09-01 Ann Clin Anal Med 2021;12(9):1021-1025

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Introduction

Cataracts are the first cause of blindness in underdeveloped countries. After cataract surgery, vision is corrected by removing the lens and replacing it with an intraocular lens (IOL).

The majority of implanted IOLs in the world are monofocal IOLs that are designed to change lens dioptric power to a single focal point and can provide only satisfying far vision, but require glasses for close vision [1]. Therefore, a wide variety of designs and optical properties have been developed to overcome this obstacle. Multifocal IOLs that have developed over the past 20 years can now supply high levels of uncorrected vision for both close visual tasks and distance. Modern multifocal IOLs provide independence from spectacles for most patients with refractive lens exchange (RLE) and cataracts. Patients were very pleased with the release of new generation lenses. However, since there are some disadvantages of the new generation lenses besides its advantages, one of these disadvantages is that when it is necessary for patients who will have a premium lens in the future, vitreoretinal surgery will be required.

One of the conditions requiring vitreoretinal surgery is the formation of epiretinal membrane (ERM), which can be seen mostly in elderly patients. ERM has an avascular, fibrocellular structure formed by proliferation on the inner surface of the Internal Limit Membrane (ILM) and causes varying levels of visual impairment [2]. ERMs that develop in normal eyes, other than the detection of a posterior vitreous detachment, are called idiopathic [2]. The mean age of ERM diagnosis is 65 years old. The incidence of idiopathic ERM is 5.8%. Its incidence is equal in men and women, and it is bilateral in 20% -30% of cases [2, 3]. In the literature, it has been reported that multifocal IOLs cause imaging difficulties during vitrectomy for retinal detachment and the epiretinal membrane (ERM) peeling [4]. On the other hand, normal imaging with multifocal IOLs during PPV has also been reported [5]. In patients with a premium intraocular lens during ERM peeling surgery, problems such as focusing on the membrane and defocus occur when the lens of the lens coincides with the optic axis of the surgeon. There are a limited number of studies in the literature evaluating visual outcomes related to ERM surgery in patients with multifocal IOLs and other macular diseases [6, 7]. However, there are very limited human studies in the literature evaluating visual results related to ERM surgery in patients with premium intraocular lenses. In this respect, our study is very important in terms of contributing to the literature.

In this study, it was aimed to evaluate the epiretinal membrane surgery challenges and results in patients with premium intraocular lens performed by an experienced surgeon in our clinic and compare with the current literature.

Material and Methods

This study was conducted at Katip Celebi University Ataturk Education and Research Hospital with the permission of the Ethics Committee of the Department of Ophthalmology. The medical files of 75 patients, all of whom were pseudophakic and underwent vitreoretinal surgery at the West Eye Institute ambulatory surgery center from March 2014 to July 2018, were analyzed retrospectively. Informed consent was obtained from all participants included in the study.

Patients and data selection

The electronic medical data of patients who had previously undergone uncomplicated phaco + iol implantation and who underwent PPV + ERM + ILM peeling surgery due to idiopathic erm at our center were scanned retrospectively. Inclusion criteria for files were as follows: a comprehensive ophthalmological examination (pre-op and post-op, written iol features, follow-up year), ERM surgery duration recorded, those with complete OCT images, and those who had a post op follow-up for at least 1 year. Inclusion criteria for iols were as follows: Alcon SA (mono), Zeiss AT LISA (Bi) or Alcon panOptix (Tri) patients. Exclusion criteria were those with ocular surface defects, those with corneal pathology, those with pupil and pathology affecting the anterior segment (pupil dysfunction), those with posterior capsulotomy and those with posterior capsular opacity, those with vitreous disorder (asteroid hyaloids), those with secondary ERM (trauma, diabetic ERM), those with optic neuropathy, those with systemic diseases (DM, HT, hyperlipidemia).

The patients were divided into three groups according to the types of intraocular lenses already inserted (Group 1: monofocal, Group 2: bifocal, Group: 3 trifocal). Age, gender, type of IOLs applied, surgery time, number of retinal nipping, logMAR (Logarithm of the minimum angle of resolution or recognition) (Pre-op/Post-op 6th month and Post-op 1st year) and CMT (Central macular thickness) (Pre-op/Post-op 6th month and Post-op 1st year) values were recorded.

Surgery procedure

All surgeries were performed under subtenon local anesthesia using the Möller-Wedel microscope. Before the surgery, the periorbital skin and eyelids were cleaned using a 5% povidone-iodine solution, and the eyelid was carefully closed to avoid the surgery area. Sclerotomy areas were carefully performed between 1 and 2 o'clock positions of the endoillumination probe and 10 to 11 o'clock positions of the vitrectomy probe. The infusion was carefully placed between 8-9 hours for the right eyes and 3-4 hours for the left eyes. After the conjunctiva displaced about 2 mm, the sclera penetrated the limbus with a 3.5 mm posterior trocar to the limbus at an angle of 25 ° to 30 ° with the 25-G one-step Kit (Alcon Laboratories, Inc, TX, USA). All vitrectomy transactions were applied utilizing a Constellation Alcon Vision System, and a noncontact lens (Eibos 90 [90D] and SPXL [132 D], Möller-Wedel, Wedel, Germany) was utilized for imaging of the posterior segment throughout the surgery. The SPXL lens was utilized during core vitrectomy and peripheral retinal control, and the 90 D lens was peeling erm during macular surgery. The working distance of the SPXL lens was 4 mm from the cornea, while the 90 D macular lens was 7 mm from the cornea. The posterior hyaloid was removed in all cases by core vitrectomy triamcinolone after standard trocars with 25 gauges. MembraneBlue-Dual (DORC International, Zuidland, the Netherlands) was used under the liquid to stain the ERM and ILM membranes. The epiretinal membrane was peeled with pinch and peel technique using a 25-G intraocular forceps (Dorc Int., Netherlands). ILM was stained again with dual dye and peeled off with the same technique. Retinal nipping was defined as involuntarily pinching of the neurosensory retina with forceps during the peeling of the ERM and ILM membranes. Scleral indentation and retinal circumference were carefully examined, and any refraction in the retina was repaired with laser retinopexy. Air liquid change was made (30-50%). Injection of 20% sf6 gas was made. Trocars were removed. Gas leakage control was done and surgery was terminated. For surgery time, the beginning was the entering of the trocars and the end was the end of the leakage check.

IOL design

IOLs used in patients are monofocal (Alcon SA or alcon iQ model) (Constellation; Alcon, Fort Worth, TX), bifocal Zeiss AT LISA 809 and diffractive aspherical trifocal alcon Panoptix iol (AcrySof-PanOptixTM, Alcon Laboratories, Inc., TX, USA). The AcrySof SA60AT IOL is monofocal, anterior asymmetric biconvex, one-piece IOL with a square edge of 6 mm. The AT-LISA-809 (Carl Zeiss) is an aspheric diffractive (bifocal biconvex) IOL. This lens is a single-piece IOL with an overall diameter of 11.0 mm and an optic diameter of 6.0 mm. The surface is divided into phase zonesand main zones; the phase zones take on the function of the steps of the main zones' diffractive power. The close vision add of this lens is +3.75 D over the distance power. The AcrySof® IQ PanOptix® Trifocal intraocular lenses (IOLs) are ultraviolet absorbing and foldable multifocal IOLs (blue light filtering). Each IOL model is a single-piece design with a central optic and two open-loop haptics. The optical diffractive structure is in the central optic portion of 4.5 mm and divides the incoming light to create a +3.25 D near and a +2.17 D intermediate add power at the IOL plane.

Statistical analysis

The data were unified and statistical analysis was supplied with SPSS v25 (SPSS Inc., USA). The Snellen value was used for visual acuity and afterwards turned to logMAR scale for analysis. The Chi-square or Kruskal-Wallis variance analysis test (post-hoc Bonferroni test) were used for comparison between groups. Paired t-test analysis was used to determine changes before and after changes in outcome variables. The p-values <0.05 were considered statistically significant.

Results

The records of 190 patients were screened retrospectively. A total of 125 patients were excluded from the study since 32 patients had undetectable iol subtypes, 5 patients had traumatic erm, 5 corneal pathologies, 23 patients had laser capsulotomy, and 60 patients had systemic diseases, lack of sufficient VA and OCT data, and lack of sufficient follow-up time.

Demographic characteristics of patients

The sociodemographic comparison of patients is shown in Table 1. There was no statistically significant difference between the groups in terms of mean age and gender (p = 0.770 and p = 0.299, respectively) (Table 1).

ERM surgery time and number of retinal nipping among iol subtypes

Comparison of patients with monofocal and multifocal (bifocal, trifocal) IOLs in terms of surgery time and the number retinal nipping is shown in Table 2. Compared to the group using monofocal IOLs, surgery time was found to be statistically significantly increased in the groups using bifocal IOLs and trifocal IOLs (p<0.001). Compared to the group using monofocal IOLs, it was found that the number of retinal nipping increased statistically significantly in groups using bifocal IOLs and trifocal IOLs (p<0.001) (Table 2). In addition, there was a significant positive correlation between surgery time and retinal nipping (p=0.001, r: 0.371**).

OCT measurements among iol subtypes

Comparison of patients with monofocal and multifocal (bifocal, trifocal) IOL in terms of logMAR and CMT is shown in Table 3. There was a statistically significant difference between the groups in terms of Pre-op, Post-op 6th month and Post-op 1st year logMAR values (p= 0.043, p=0.031, and p=0.016, respectively). In terms of Pre-op, Post-op 6th month and Post-op 1st year logMAR values, there was a statistically significant increase in group bifocal and trifocal compared to group monofocal (p=0.034, p=0.012, and p=0.008, respectively).

Table 1. The sociodemographic comparison of patients with monofocal and multifocal (bifocal, trifocal) IOLs.

	Monofocal (n=25)	Bifocal (n=25)	Trifocal (n=25)	P value
	Median (min-max) or Number (%)			
Age	60,0 (46,0-75,0)	60,0 (43,0-72,0)	59,0 (43,0-72,0)	0.770
Gender				0.299
Male	12 (48)	10 (40)	11 (44)	
Female	13 (52)	15 (60)	14 (56)	

Table 2. Comparison of patients with monofocal and multifocal (bifocal, trifocal) IOLs in terms of surgery time and retinal nipping

	Monofocal (n=25)	Bifocal (n=25)	Trifocal (n=25)	P value
	Median (min-max) or Number (%)			
Surgery time (minutes)	29,00 (22,0-38,0)	35,00 (27,0-42,0)	36,00 (28,0-42,0)	<0.001
Retinal nipping (number)	1,00 (0,0-2,0)	2,00 (1,0-4,0)	2,00 (0,0-3,0)	<0.001
0	8 (32,0)	0	1 (4,0)	
1	12 (48,0)	7 (28,0)	5 (20,0)	
2	5 (20,0)	8 (32,0)	11 (44,0)	
3	0	9 (36,0)	8 (32,0)	
4	0	1 (4,0)	0	

Table 3. Comparison of patients with monofocal and multifocal (bifocal, trifocal) IOL in terms of logMAR and CMT

	Monofocal (n=25)	Bifocal (n=25)	Trifocal (n=25)	P value
	Median (min-max) or Number (%)			
Pre-op logMAR	0,39 (0,15-1,00)	0,52 (0,15-1,30) a	0,52 (0,15- 0,69) a	0.043 a:0.034
Post-op 6th month logMAR	0,22 (0,04-0,52)	0,30 (0,09-0,52) a	0,30 (0,15-0,39) a	0.031 a:0.012
Post-op 1st year logMAR	0,15 (0,04-0,39)	0,22 (0,04-0,39) a	0,22 (0,04-0,30) a	0.016 a:0.008
P value (logMAR)	<0.001 b	<0.001 b	<0.001 b	
Pre-op CMT (µm)	355,0 (272-540)	348,0 (267-517)	380,0 (268-455)	0.869
Post-op 6th month CMT(µm)	237,0 (218-270)	245,0 (210-302)	243,0 (222-285)	0.215
Post-op 1st year CMT (µm)	227,0 (212-257)	236,0 (205-282) a	228 (205-264) a	0.361
P value (CMT)	<0.001 b	<0.001 b	<0.001 b	

logMAR: Logarithm of the minimum angle of resolution or recognition, CMT: Central macular thickness. a: compared to Monofocal. b: compared among Pre-op, Post-op 6th month, and Post-op 1st year.

In addition, when the pre-op, post-op 6th month and post-op 1st year logMAR values in the groups were compared, it was found that the logMAR values in Post-op 6th month and Post-op 1st year decreased statistically significantly compared to Pre-op logMAR (p<0.001). In other words, the median visual acuity improved at post-operative month 6 and post-operative year 1 in all 3 groups. Final visual acuity (at post-operative year 1) was significantly worse in patients with multifocal lenses when compared to patients with monofocal lenses.

There was no statistically significant difference between the groups in terms of pre-op, post-op 6th month and post-op 1st year CMT values (p = 0.886, p = 0.215 and p = 0.361, respectively). In addition, when comparing the Pre-op, Post-op 6th month and Post-op 1st year CMT values in the groups, it was found that CMT values in Post-op 6th month and Post-op 1st year decreased statistically significantly compared to Pre-op CMT (p<0.001) (Table 3).

Discussion

In our study, we compared our epiretinal membrane surgery results in patients who had previously undergone phacoemulsification with different types of iol implantations. To the best of our knowledge, this is the first study in the published literature. We showed that surgery time increased statistically significantly in groups using bifocal and trifocal IOLs. It was also found that the number of retinal nipping increased statistically significantly in groups using bifocal and trifocal IOLs, and there was a significant positive correlation between surgery time and retinal nipping. Furthermore, BCVA was better in monofocal compared to multifocal in logMAR at all times.

A curious question about presbyopia correction is whether IOLs block imaging for retinal work. In general, lenses that can provoke problems are multi-focused, as they have diffraction or optical zones with changing power. However, various studies have reported that the posterior pole imaging is comparable to monofocal IOLs [10], while other studies have objected [11]. A study of nine retinal surgeons in the first author's study reported that a few have had macular visualization problems with current multifocal lenses. In the case of smaller optical designs, such as crystalline optics, the environment may be more difficult due to the rapid alteration in optical power encountered when the lens crosses the optical edge [12]. In our study, the total retinal nipping count was calculated as 17 in the Monofocal iol group, 25 in the bifocal iol group, and 24 in the trifocal iol group, and compared to the group monofocal IOLs, it was found that the number of retinal nipping increased statistically in groups bifocal and trifocal IOLs. In addition, there was a significant positive correlation between surgery time and retinal nipping.

Integrated phacovitrectomy has represented efficacy, and the argumentation of lens options (eg. monofocal, bifocal, trifocal) is an accepted standard of care for all patients undergoing cataract extraction [14]. A study by Hadayer et al and other researchers have reported that applying PPV potential difficulty through a multi-focal IOL (bifocal and trifocal) because of impaired fundus visualization and intraoperative difficulties (additional effort needed to focus on the retinal vessels and peripheral retina, decreased stereopsis, and weaken view after fluid–air exchange) [15]. Yoshino et al. and Kawamura et al. showed that imaging difficulties during vitrectomy for ERM peeling are caused by retinal detachment and diffractive IOLs [4]. Otherwise, Marques et al. showed standard imaging with diffractive IOL during PPV [5]. In our study, while patients with trifocal IOLs did not have a focal problem in imaging the peripheral retina (similar to monofocal), focusing problems were experienced during peripheral retinal control with bifocal IOLs. However, the number of retinal nipping was found to be increased in patients with trifocal and bifocal IOLs.

Different strategies have been applied to achieve independence from eyeglasses and better visual acuity after cataract surgery, and there are many options related to intraocular lenses (IOL). In many studies in the literature, it was stated that, although there is uncertainty as to the size of the effect, multifocal IOLs are potent at improving near vision relative to monofocal IOLs [16, 17]. However, some studies reported similar logMAR values in both groups [17]. One study reported lightly preferable logMAR values in the monofocal group and one study reported substantially better logMAR values in the multifocal group [17]. Only two studies assessed the visual outcome of MIOLs in patients with concurrent retinal diseases. Kamath et al. showed that patients with concurrent eye diseases, including diabetic retinopathy, glaucoma, or age-related macular degeneration, benefited from a multifocal IOL and distance visual acuities were similar in the monofocal IOL and multifocal IOL groups [7]. Gayton et al. reported that in cataractous eyes with age-related macular degeneration and corrected distance, visual acuity was worse in the MIOL group [6]. In our study, in terms of Pre-op, Post-op 6th month and Post-op 1st year logMAR values, there was a statistically significantly increase in the bifocal and trifocal group compared to the monofocal group. In addition, when the Pre-op, Post-op 6th month and Post-op 1st year logMAR values in the groups were compared, it was found that the logMAR values in Post-op 6th month and Post-op 1st year decreased statistically significantly compared to Pre-op logMAR. In other words, median visual acuity improved at post-operative month 6 and post-operative year 1 in all 3 groups. Final visual acuity (at post-operative year 1) was significantly worse in patients with multifocal lenses compared to patients with monofocal lenses.

The drawbacks associated with multifocal IOLs design are loss of contrast sensitivity, an increase in higher-order aberrations, and night-time glare and halos [18, 19]. In a few studies in the literature, the authors found no differences in retinal macula thickness, retinal volume, or fundoscopic photographs between monofocal and multifocal iols [18, 19]. Aychoua et al. showed a relevant reduction in visual sensitivity in patients with multifocal IOLs [19]. Another study reported wavy horizontal artifacts on OCT line scanning ophthalmoscopy images in patients with multifocal IOLs [18]. In a study by Lee et al., central macular thickness significantly decreased in patients with monofocal lens after surgical removal of the idiopathic macular epiretinal membrane [20]. In our study, when comparing the Pre-op, Post-op 6th month and Post-op 1st year CMT values in the groups, it was found that CMT values in Post-op 6th month and Post-op 1st year decreased statistically significantly compared to Pre-op CMT. However, there was no statistically significant difference between the groups in terms of pre-op, post-op 6th month and post-op 1st year CMT (Central macular thickness) values.

The study has some limitations. This study was carried out only by a surgeon in a center and without a control group and was a retrospective study. Second, post-op near vision could not be observed because it was retrospective. However, it should be accepted that it is difficult to find a patient who has a Premium lens and underwent retinal surgery. Therefore, although it is retrospective, we think that it is a strong study in terms of the number of patients and it can be evaluated as a preliminary pilot study for future studies.

Conclusion

Premium lenses prolong surgery time during vitreoretinal surgery. Since premium iols negatively affect visual acuity, it should not be recommended for patients with retinal disease. However, with careful preoperative planning, proactive familiarity with these premium IOLs, and proper contact with patients, retinal surgeons do not need to fear these sophisticated lenses.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:

Berkay Akmaz, Ugur Unsal. Epiretinal membrane surgery challenges and results in patients with premium intraocular lens. Ann Clin Anal Med 2021;12(9):1021-1025